IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Appl. No.	:	10/681,497
Applicant	:	Stephen G. Bales
Filing Date	:	October 27, 2003
Title	:	Lignocellulosic, Borate Filled, Thermoplastic Composites
Examiner:		Matthew J. Daniels
Art Unit	:	1732
Docket No.	:	LA 001
Customer No.		000048373

Declaration Under 37 CFR 1.132

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Sir:

City of Sewell, NJ
County of Gloucester
State of New Jersey

I, Stephen G. Bales, declare that all the statements made of my own knowledge are true, and that all statements made on information and belief are believed to be true:

1. The present invention discovered that calcium borate (CB) in loadings of about 1.5 to 10 percent and preferably from about 3 to 5 percent will significantly resist wood plastic composite (WPC) surface discoloration due to mold. This result, which was determined by visual examination and by spectrophotometer measurements, was unexpected. Although prior art described the use of this borate compound to provide resistance to

fungi that decay wood composites (WC) there was no prediction of an ability to control mold on WPC surfaces.

2. A major use of lignocellulosic thermoplastic composites, commonly called wood-plastic composites (WPC's), is in outdoor applications, especially in the manufacture of decking material. This environment subjects the WPC products to conditions that allow the growth of fungi – food (the lignocellulosic material), oxygen, and water. These fungi produce two different problems: decay and surface discoloration.

3. As described in "Understanding Biodeterioration of Wood in Structures, p 7 -11" (First Supplemental IDS, Cite #4) published by Forintek, wood decay is caused by a specific type of fungus called *Wood Rotting Basidiomycetes* (WRB). The WRB's attacking wood plastic composites are white rot and brown rot. White rot fungi primarily degrade lignin, removing it and leaving white cellulose. *Trametes versicolor* (Taxonomy: Polyporaceae, Polyporales, Agaricomycetidae, Basidiomycetes, Basidiomycota, Eumycota) is the white rot fungus most often used in testing for lignocellulosic decay. Brown rot fungi degrade the cellulose and in the process the rotted wood turns a brownish color. Again only a few fungi produce brown rot and all are WRB's. The most common one used in lignocellulosic decay testing is *Gloeophyllum trabeum* (Taxonomy: Gloeophyllaceae, Polyporales, Agaricomycetidae, Basidiomycetes, Basidiomycota, Eumycota).

4. Lloyd (USPN 6368529) teaches calcium borate (CB) as an additive that provides resistance to attack by wood destroying fungi and insects (Abstract). Lloyd states "The amount of calcium borate incorporated in the composite is a pesticidal amount; that is an amount sufficient to control or kill fungi and/or insects that destroy wood and similar cellulosic-based composite products (3: 53–56). The information in Lloyd's Example 1 clearly indicates that his teaching is the use of CB to resist decay fungus: the test fungus are WRB's –*Trametes versicolor* and *Gloeophyllum trabeum,* the soil block test is the standard approach to testing for decay, and weight loss percent described in the example is the metric used to determine the degree of lignocellulosic decay.

5. As described in the Fornitek document and confirmed by the taxonomies, there is a distinct difference between mold fungus and decay fungus. Mold fungi, commonly called mildew, are ubiquitous and resistant to desiccation and UV radiation. Examples of mold fungi are *Aspergillus niger* (Taxonomy: Trichocomaceae, Eurotiales, Eurotiomycetidae, Ascomycetes, Ascomycota, Eumycota) and *Talaromyces lutes* (Taxonomy: Talaromyces, Eurotiaceae, Elaphomycetales, Eurotiomycetes, Euascomycota, Ascomycota). Unlike *Wood Rotting Basidiomycetes* which can reduce the strength and introduce structural problems in WPC materials, mold fungi cause no structural damage but do create an unsightly appearance. The best known way to limit mold germination is to eliminate sources of moisture; this is impossible in outside WPC decking material. The colored spores produced by mold fungi are responsible for the

unsightly mildew patches that develop, sometimes rapidly, on WPC surfaces and the discoloring growth must be brushed and/or washed off the material.

6. The August 9, 2005 Office Action states that this present invention is unpatentable over Aida (USPN 5221781) in view of Lloyd (USPN 6368529). As described in the written response to the OA that accompanies this declaration, Applicant strongly disagrees that these two teachings can be combined as described in the OA. However, for purposes of completeness of this declaration, Applicant also asserts that even if Lloyd could be combined into Aida, that combination would not yield the unexpected results discovered with this present invention. Applicant asserts neither Lloyd's demonstrated range (0.5 to 2%) or claimed general use range (0.1 to 4%) is sufficient to either discover this result or to provide adequate mold resistance coverage.

7. A critical process in wood preservation range analysis is the determination of the minimum loading required to meet a desired condition. Testing at higher levels then follows to ascertain the dose-response function verifying that the benefit is sustained at increased levels and is not a unique occurrence at a particular loading. This is especially important with WPC's since they contain multiple additives, some of which can actually increase mold growth.

Unlike decay testing, where the critical condition is defined as an agreed upon maximum weight loss condition, determination of the degree of surface discoloration requires stratification analysis. Comparison of the stratification between samples at the 0, 1, 2, 3, 4, and 5 % loadings using visual inspection and color instrument

measurements was required to make the discovery that CB did have a valid dose response function to mold growth and that the preferred range was 3 to 5%. This is illustrated by the instrument measurement of luminosity change (Δ L) that occurred over the 18 month period. Darker color, as measured by a decrease in L value, is indicative of increased biological soiling on the sample surface. At the 18 month period, 3 percent was the lowest loading with a positive ΔL; that is the 3 percent sample was a lighter color at 18 months than at test initiation. The Δ L reading remained positive at a 4% loading but its magnitude decreased over 60%, requiring examination at the 5 percent to verify the borate was producing a valid dose response function. It also confirmed that the preferred range was 3 to 5 percent.

Once a valid dose response function was verified and a preferred range determined, the general use range was identified by an assessment of a reasonable set of possible conditions that will exist outside the test conditions; this approach appears to be the same one used by Lloyd. His preferred range, which is also his test range, is 0.5 to 2 percent. However his general range is from about 0.1 to about 4 percent as he states the amount used will vary with environmental conditions and required lifetime. Since WPC decking material can be exposed to extremes in environmental conditions and lifetime requirements exceeding 20 years, the general use range of this invention is 1.5 to 10 percent. Lloyd's restricted range is inadequate while Aida's range for zinc borate with inorganic fillers, which Applicant argues may not exist and at least is 40 -200 parts per 100 parts of resin, starts at such a high level and is so broad that it provides no assistance in determining the dose response function.

8. I acknowledge that willful false statements and the like are punishable by fine and/or imprisonment, and may jeopardize the validity of the application of any patent issuing therefrom.

17 Hart Lane, Sewell, NJ 08080

Sworn in the State of New Jersey, County of Gloucester

In the State of New Jersey, this 22nd day of November , 2005

Witness my hand and official seal.

My Commission Expires: 14 July 2009

Notary Public

GABRIELE S. MASTROBUONO
Notary Public - New Jersey
My Commission Expires July 14, 2009